

## Energy and Atmosphere

Using energy wisely is a cornerstone of sustainable design. LEED recognizes the importance of optimizing energy performance by allocating the greatest number of potential points within this category. In general, points can be earned through efficient design, use of renewable energy, deliberate mechanical and electrical system selection, and proper commissioning and monitoring. Because energy savings translate directly into operational savings, Energy and Atmosphere credits typically have the highest payback of all LEED credits for the owner. Many opportunities exist within this category for synergistic design, and it is best to get the engineering team engaged early in the design process to encourage a successful, integrated design process.



Poudre School District - Fossil Ridge High School

*Courtesy: RB+ B Architects*

## EA Prerequisite 1: Fundamental Building Systems Commissioning

Building commissioning is a comprehensive and systematic process to verify that new buildings are designed and constructed to meet or exceed the original design intent. Commissioning is essential to building performance and is a prerequisite in the Energy and Atmosphere LEED category.

Commissioning can be very cost effective. A study of over 200 commercial buildings by Lawrence Berkeley National Laboratories found that commissioning results in a median 4.8 year payback. Catching potential mistakes early in design reviews or prior to equipment installation can provide significant cost savings to the project.

While the commissioning agent for this credit is required to be independent, they may work for the project's design or construction company, so long as they are not responsible for the building design or construction. This contrasts with the Additional Commissioning credit EAc3 which requires the commissioning agent to be both independent and from a third party company that is not a part of the design or construction team.

The primary requirements of the prerequisite are independent design reviews and functional testing. These activities can provide tremendous value to the owner and the design teams because potential problems are identified at the earliest possible point. Project specifications must include commissioning language to ensure commissioning is properly addressed. In addition, the inclusion of commissioning specifications insures that contractors and subcontractors know their work will be verified by a commissioning agent independent of the design team.

As part of the prerequisite, the commissioning agent must produce a Commissioning Plan that describes the implementation of the commissioning process and provides a framework for integrating commissioning activities into the construction and acceptance process. The commissioning plan and the design reviews will serve as supporting documentation for the prerequisite.

### QUICK FACTS

**Implementation:** Required.



Commissioning Field Work  
*Courtesy: Architectural Energy Corporation*

### Recommendation:

- The commissioning agent will need to coordinate and set up meetings with the contractors and subcontractors on-site. Incorporate the commissioning agent's milestones into the project schedule.

### Helpful Hints:

- The commissioning agent should be contracted as soon as possible in the design process, ideally during programming or conceptual design stages.
- This credit has synergy and cost savings with additional commissioning credit EAc3, so be aware of both the prerequisite and the credit when scoping and bidding this work.
- This credit has synergy and cost savings with measurement and verification activities in credit EAc5, so be aware of both credits when scoping and bidding this work.
- LEED only requires HVAC&R systems be commissioned, but it is recommended that fire protection, security, IT, medical gas, etc. be considered, as well.

### Example:

- The University of Colorado in Boulder is performing its own commissioning on both the Wolf Law School and the ATLAS Center. Since they are the owner and not part of either the Design Team or the Construction Team this is acceptable.

**Resources:**American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

ASHRAE Guideline 0P- *The Commissioning Process* is still in development. ASHRAE Guideline 1-1996 *The HVAC Commissioning Process* is available at the ASHRAE website along with other articles and commissioning resources.

Website: [www.ashrae.org](http://www.ashrae.org)

National Institute of Building Sciences (NIBS)

NIBS has a total building commissioning process that provides resources and guidelines for building commissioning being developed under the auspices of the National Institute of Building Sciences.

Website: [www.nibs.org](http://www.nibs.org)

Building Commissioning Association (BCA)

BCA has published a popular Building Commissioning Handbook that gives an overall understanding of the commissioning process. The association also offers a list of members, an online forum and electronic newsletter.

Website: [www.bcxa.org](http://www.bcxa.org)

Portland Energy Conservation Inc. (PECI)

PECI was the founder of the National Conference on Building Commissioning and has numerous resources such as a model commissioning plan and guide specifications, a guide for commissioning existing buildings, and training seminars on commissioning practices.

Website: [www.peci.org](http://www.peci.org)

Energy Design Resources (EDR)

EDR is a guide to energy efficient design practices and includes information on the commissioning process. It has many building commissioning resources on their website including design briefs, design guidelines, electronic articles and more.

Website: [www.energydesignresources.com](http://www.energydesignresources.com)

Governor's Office of Energy Management & Conservation (OEMC)*Rebuild Colorado Business Partners*

This directory includes contact information for commissioning agents that serve Colorado.

Website:

[www.colorado.gov/rebuildco/partners/business.htm](http://www.colorado.gov/rebuildco/partners/business.htm)

Governor's Office of Energy Management & Conservation (OEMC)*Commissioning*

OEMC offers a brief introduction to commissioning, why it's needed, and includes rules of thumb for budgeting for commissioning.

Website:

[www.colorado.gov/rebuildco/services/commissioning.htm](http://www.colorado.gov/rebuildco/services/commissioning.htm)

***Starting a new LEED-NC project?***

*All new LEED-NC projects will register under version 2.2 (as of January 2006).*

*Refer to the USGBC for complete information about version 2.2. Also, see Appendix C of this Guide for a quick overview of the changes from version 2.1 to 2.2.*

## EA Prerequisite 2: Minimum Energy Performance

While in certain jurisdictions compliance with minimum energy performance standards are mandated by code, the State of Colorado has energy guidelines rather than a minimum energy performance requirement. Nevertheless, meeting the LEED Minimum Energy Performance prerequisite is straightforward and should be standard design practice.

To achieve the minimum energy compliance for this credit, as gauged by ASHRAE Standard 90.1-1999, the building should start with a good envelope. This means complying with, or exceeding, building envelope requirements as found in Appendix B of the ASHRAE standard. Generally, this means at least double-pane low-E glazing and well insulated walls and roof, typically with continuous insulation for colder climates. If mechanical equipment meets minimum ASHRAE requirements, maximum lighting power densities are not exceeded, and the numerous *mandatory* provisions are met (for example, automatic lighting control) *generally*, the building will meet minimum compliance for EAp2.

### Recommendations:

- Ensure this prerequisite early: Confirm with the mechanical engineer and electrical engineer that the design will meet all ASHRAE minimum and mandatory compliances for this credit.
- The documentation for the Minimum Energy Performance Prerequisite can either be produced by the mechanical engineer (typically using prescriptive methods) or by the Energy Modeler who produces the documentation for EAc1 (based on performance calculations).

### Helpful Hints:

- For best results, consider mechanical and electrical engineers for the project team whose standard practice meets or exceeds this prerequisite.
- The Federal Energy Policy Act of 2005 contains revisions to energy codes and incentives to exceeding energy codes. Refer to the Act and resulting policies that may impact your building.
- Refer to the discussion for Optimize Energy Efficiency, EAc1, for energy-saving strategies.

### QUICK FACTS

**Implementation:** Required.



**Colorado Springs Utilities Laboratory** uses high-efficiency lighting with diffusers, automated dimming, photo sensors, and interior windows that provide shared lighting.  
*Courtesy: Ed LaCasse Photography*



**University of Denver Ricketson Law Building**  
The energy-efficient design of this LEED-NC Gold certified building is expected to save the college 40 percent on energy costs.  
*Courtesy: H+L Architecture*

**Resources:**Referenced standard- ASHRAE/IESNA Standard 90.1-1999: Energy Standard for Buildings Except Low-Rise Residential

ASHRAE Standard 90.1 sets the minimum energy efficiency requirements used by LEED as long as the local code is not more stringent. Depending on what building/mechanical code the project is using, designers will need to check and make sure they are meeting the most stringent standards for the LEED submittal. ASHRAE Standard 90.1-1999 is available at the ASHRAE website.

Website: [www.ashrae.org](http://www.ashrae.org)

Website:

[www.coloradoenergy.org/codes/colorado.asp](http://www.coloradoenergy.org/codes/colorado.asp)

American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)

ASHRAE has published a Standard 90.1-2004 User's Manual that can be used in conjunction with the standard. It streamlines compliance calculations with examples, standard forms and reference materials. This resource can be purchased on the ASHRAE website.

Website: [www.ashrae.org](http://www.ashrae.org)

ENERGY STAR

Energy Star is a federal government program that provides resources for improving the energy efficiency of buildings, processes and products. Resources such as guidelines for energy management, service and product provider listings and energy efficiency programs can be found at the website.

Website: [www.energystar.gov](http://www.energystar.gov)

ColoradoEnergy.org

For a list of energy codes in Colorado by county, see the Colorado Energy website. Check with the project leader to make sure this is the code being used because it might vary by project.

Website: [www.coloradoenergy.org](http://www.coloradoenergy.org)

Building Energy Code Program (BECP)

BECP is an information resource from the DOE that intends to inform users about national and local energy codes. Resources on the website include compliance tools, training, education and general code information.

Website: [www.energycodes.gov](http://www.energycodes.gov)

U.S. Energy Policy Act of 2005Tax Credits

The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.

Website: [www.energy.gov/taxbreaks.htm](http://www.energy.gov/taxbreaks.htm)



## EA Prerequisite 3: CFC Reduction in HVAC&R Equipment

Reducing or eliminating the use of chlorofluorocarbons (CFCs) is known to reduce ozone depletion. The Montreal Protocol of 1987 was an agreement by 160 countries including the U.S. to phase out the use of CFCs. This prerequisite, therefore, is achieved if the project uses new packaged equipment. If the project's mechanical design incorporates an existing central cooling plant, or existing base building equipment which uses CFCs, however, a comprehensive CFC phase-out plan must be implemented to meet this prerequisite.

### Recommendation:

- If your project is planned for a campus setting and/or relies on the use of a central plant, identify the coolant used in the central plant early and research the numerous Credit Interpretations Rulings (CIRs) regarding central plants for this prerequisite.

### Helpful Hints:

- This credit has ties to EAc4, Ozone Protection, so be aware of both when specifying HVAC equipment. An additional point is available if the coolant is also HCFC free; see EAc4.

### Examples:

- The Tutt Science Center at Colorado College was able to meet this prerequisite by referencing a CIR ruling dated 2/15/2002 (0323-EAp30-03502) which states that emergency back-up chillers that are CFC-based are not included in the prerequisite requirement.
- The University of Colorado is carrying out a five-year phase out plan to eliminate CFC usage in its central chiller plant which qualifies to meet the prerequisite.

### Resources:

#### ARI: Air-Conditioning and Refrigeration Institute

ARI is a knowledgeable source for refrigerant information. It provides standards, white papers and guidelines that involve fluorocarbon refrigerants.

Website: [www.ari.org](http://www.ari.org)

### QUICK FACTS

**Implementation:** Required.



**Colorado College Tutt Science Center**

Laboratory classroom

Courtesy: Colorado College

#### Significant New Alternatives Policy (SNAP)

SNAP is a great resource to identify alternative refrigerants that will satisfy the LEED prerequisite. It also includes global warming potential values, toxicity information and manufacturer information.

Website:

[www.epa.gov/ozone/snap/general/index.html](http://www.epa.gov/ozone/snap/general/index.html)

#### Building Owners Management Association (BOMA)

*The Refrigerant Manual: Managing the Phase-Out of CFCs*

BOMA has published a manual that includes owner options for refrigerant compliance, case studies, ruling from the EPA and much more.

Website: [www.boma.org](http://www.boma.org)

#### International council of Air-Conditioning and Refrigeration Manufacturers' Association (ICARMA)

ICARMA has developed a program that evaluates the performance and presents data on new and existing refrigerants. This Program is called the Global Refrigerant Environmental Evaluation Network (GREEN).

Website: [www.icarma.org](http://www.icarma.org)

## EA Credit 1: Optimize Energy Performance

This credit poses the largest potential for point accumulation within the LEED system. It accounts for mechanical system performance, lighting power densities, solar hot water contributions and many other strategies which enhance energy performance. It is important to note, however, that LEED awards credit based on energy *cost* savings rather than energy *use* savings. Energy performance is calculated relative to a baseline as defined by ASHRAE or the local energy code, whichever is more stringent. It is best to consult with an energy modeler or consultant to see how various energy saving strategies will impact overall energy costs. LEED documentation requires energy calculations or hourly modeling results to be presented using the Energy Cost Budget (ECB) method as defined in the LEED Reference Guide. Most projects achieve an average of two points for this credit. However, significantly higher point awards are possible for more efficient buildings.

### Recommendations:

- The Colorado climate is particularly conducive to certain energy saving strategies. Refer to the list later in this section for more detail.

### Helpful Hints:

- EAc1 example documentation is available on the USGBC website. It is best to follow the USGBC format precisely and not use custom tables or graphs.
- Due to inherent variations in mechanical design requirements for differing building types (recreation centers versus office buildings, for example) many issues have been raised surrounding the energy modeling requirements of this credit. In some cases, separate guidelines (e.g. LEED for Labs) are being developed specifically to address perceived shortcomings in the current energy performance evaluation system. In general, it is best to work with an energy modeler who is versed in LEED Energy Cost Budget requirements to best estimate the percentage of energy cost savings that will be approved by the USGBC for a given project or building type.

### QUICK FACTS

**Implementation:** Strongly recommended.

**Historical Data:** 100% of Colorado LEED certified projects have successfully earned *at least two points* for this credit. One project to date has earned *ten points*, which is the maximum available.



**Fossil Ridge High School** uses details such as tilting windows in a west wall to minimize summer overheating.

*Courtesy: RB+B Architects*



**Fossil Ridge High School Condensing Boilers**

Time and money spent on fine-tuning the energy efficiency, yields savings because the school uses much smaller heating, cooling and electrical systems.

*Courtesy: Governor's Office of Energy Management & Conservation*

- The USGBC allows interpolation of energy costs savings to establish point thresholds. See [https://www.usgbc.org/Docs/LEEDdocs/Amendment\\_LEED-NC2%200-EAc1-133%20PDF.pdf](https://www.usgbc.org/Docs/LEEDdocs/Amendment_LEED-NC2%200-EAc1-133%20PDF.pdf) for amended point interpolation tables.
- To maximize the points in this credit, consider renewable energy-based HVAC systems or systems that use waste heat recovery.
- Consider incorporating energy performance contracting as a way of financing additional energy efficiency in new buildings.
- The Federal Energy Policy Act of 2005 offers tax incentives of \$1.80 per square foot for new commercial buildings designed to exceed the ASHRAE Standard 90.1 standard by 50 percent or more.

**Examples:**

- Fossil Ridge High School is the only project to date to earn all ten LEED points for this credit. The design projected 59 percent energy cost savings. The district annually saves over \$80,000 per year in lower energy costs compared to a similar size school built ten years earlier. Energy efficiency measures included an efficient building envelope, high performance glazing, high efficiency lighting, condensing boilers, and exhaust heat recovery.
- The North Boulder Recreation Center projected to achieve 36.7 percent energy cost savings and earned five LEED points for EAc1. Energy efficiency measures included efficient lighting, solar hot water heating, occupancy sensors, increased roof insulation and white roofing, as well as increased heating system efficiency.

**Energy Saving Strategies**

- ✓ Improved building envelope including greater insulation, high quality glazing and light reflective roofing materials.
- ✓ Heat recovery wheels utilized to preheat and precool make up air.
- ✓ High efficiency HVAC equipment including high efficiency condensing boilers, automated building systems controls and occupancy sensors.
- ✓ Thermal Energy Storage (TES) system shifts peak demand for cooling loads and can reduce chiller size by half, using ice storage.
- ✓ Evaporative Cooling. This is a particularly effective strategy in the dry Colorado climate and also eliminates the use of refrigerants from the design, which provides synergies with LEED EAc4. The University of Colorado has extensive experience and success using Evaporative Cooling in their buildings. Contact Pieter van der Mersch, Department of Facilities Management at CU (303-492-2909) for more information.
- ✓ Low Lighting Power Densities (LPDs). Lower wattage electrical lighting designs typically produce electrical energy savings, as well as savings in mechanical cooling.
- ✓ Advanced daylighting coupled with proper solar control (shading and high performance glass) and automated electric light integration can save energy costs through reduced electrical lighting, as well as mechanical savings. Automated technologies including daylighting sensors and dimmable ballasts will help to reduce energy use further.
- ✓ Solar Hot Water Systems. Note that Solar Hot Water Systems do not count towards the Renewable Energy Credit (EAc2) but do contribute to the overall energy cost savings of a project to support this credit.





**North Boulder Recreation Center's** solar water system helped the project earn five points for this credit (rather than the other renewable energy credits.) The system saves the city money year after year by reducing the amount of natural gas needed.

*Courtesy: Barker Rinker Seacat Architecture*

## Resources:

*See Appendix G for sources of grants and incentives for high performance design.*

### Governor's Office of Energy Management and Conservation (OEMC)

#### *Rebuild Colorado*

Resources for high performance design, including grants for state-owned new construction projects using LEED.

[www.colorado.gov/rebuildco](http://www.colorado.gov/rebuildco)

### Governor's Office of Energy Management and Conservation (OEMC)

#### *Business and Strategic Partners*

OEMC maintains a directory of both business and strategic partners (e.g. nonprofits, associations, government groups, etc.) to assist Colorado businesses in improving energy efficiency.

Website:

[www.colorado.gov/rebuildco/partners/index.html](http://www.colorado.gov/rebuildco/partners/index.html)

### Colorado Greening Government

#### *Energy Efficiency*

Information for Colorado state government and others on executive orders, performance contracting, high performance design, energy management and LEED.

Website:

[www.colorado.gov/greeninggovernment/programs/energy](http://www.colorado.gov/greeninggovernment/programs/energy)

### Energy Design Resources (EDR)

#### *Design Practices: Integrated Energy Design*

Energy Design Resources offers a valuable palette of energy design tools and resources that help make it easier to design and build energy-efficient commercial and industrial buildings.

Website:

[www.energydesignresources.com/category/integrateddesign/](http://www.energydesignresources.com/category/integrateddesign/)

### U.S. Department of Energy

#### *Energy Efficiency and Renewable Energy*

This resource highlights information on the DOE programs on energy efficiency and renewable energy as well as provides additional links to websites and online documents.

Website:

[www.eere.energy.gov](http://www.eere.energy.gov)

### Whole Building Design Guide (WBDG)

The WBDG is a web-based portal providing government and industry practitioners with one-stop access to up-to-date information on a wide range of building-related guidance, criteria and technology from a whole building perspective.

Website: [www.wbdg.org](http://www.wbdg.org)

### U.S. Energy Policy Act of 2005

#### Tax Credits

The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.

Website: [www.energy.gov/taxbreaks.htm](http://www.energy.gov/taxbreaks.htm)

## EA Credit 2: Renewable Energy, 5%, 10%, or 20%

In the past, few projects have pursued this point because even the lowest threshold of producing 2.51 percent (see interpolation table, below) of the building's total energy cost through renewables can be cost prohibitive. However, Colorado Amendment 37 will allow eligible Colorado projects to receive money credits for installing on-site renewable generation systems. In some cases, a building owner may elect to install demonstration renewable energy systems (solar powered parking lot lighting, for example) as a visible expression of support for renewable energy and sustainability, while the systems may not be sufficient to earn LEED credit. The Energy Policy Act of 2005 also offers incentives for renewable energy use.

### Recommendations:

- Research the applicability of Colorado Amendment 37 or other grants to your particular project that make installing renewable generation systems more attractive and affordable.
- The Federal Energy Policy Act of 2005 allows a 30 percent tax credit to businesses for installing fuel cell technology (up to \$500 credit for each half kilowatt of electrical capacity).

### Helpful Hints:

- The USGBC has published an interpolation table for calculating points for this credit. It is as follows:
 

2.51 - 7.50 %	1 point
7.51 - 15.50 %	2 points
> 15.51 %	3 points
- The installation of renewable energy generation systems (wind, photovoltaics, biomass etc.) may be incorporated into an education and outreach program for an Innovation in Design credit.
- This credit has synergies with EAc1 energy saving calculations. In a certain sense, renewable energy generation is doubly rewarded by the LEED rating system.
- Purchased offsite renewable energy is addressed in the Green Power credit EAc6.
- Hot water solar systems are not included in this credit. Instead they are credited through an increase in energy efficiency in EAc1.

### QUICK FACTS

**Implementation:** Worth considering.

**Historical Data:** 0% of Colorado LEED certified projects have successfully earned this credit.



**Fossil Ridge High School** photovoltaic array  
*Courtesy: RB+B Architects*

### Examples:

- Belmar Development Project in Lakewood plans to install small wind turbines at the top of parking lot lighting to power the individual fixtures.
- Fossil Ridge High School includes a photovoltaic array at the entrance of the building. The array provides an educational opportunity for the district, but was not large enough to qualify for this credit.

**Resources:**

*See Appendix G for sources of grants and incentives for high performance design.*

Referenced standard- ASHRAE/IESNA Standard 90.1-1999: Energy Standard for Buildings Except Low-Rise Residential  
Renewable or recovered energy that is produced at the site is considered free energy by the Energy Cost Budget (ECB) Method, and therefore, is not included in the Design Energy Cost. ASHRAE Standard 90.1 is the energy standard used by LEED.

Website: [www.ashrae.org](http://www.ashrae.org)

Colorado Solar Energy Industries Association (COSEIA)

COSEIA promotes the use of renewable energy in Colorado and maintains a helpful directory of a variety of industry members (manufacturers, distributors, etc) in Colorado.

Website: [www.coseia.org](http://www.coseia.org)

Colorado Renewable Energy Society (CRES)

CRES promotes the use of renewable energy in Colorado with information, annual conference, meetings and annual awards.

Website: [www.cres-energy.org](http://www.cres-energy.org)

Governor's Office of Energy Management & Conservation (OEMC)

*Colorado Biomass Information Clearinghouse*

This clearinghouse provides research and resources for using biomass in Colorado.

Website: [www.state.co.us/oemc/biomass/](http://www.state.co.us/oemc/biomass/)

Governor's Office of Energy Management & Conservation (OEMC)

*Wind Energy Program*

Provides wind resource map for Colorado, loans of anemometers to measure wind resource for small wind generation projects, and video.

Website:

[www.state.co.us/oemc/programs/renewable/wind/energy.htm](http://www.state.co.us/oemc/programs/renewable/wind/energy.htm)

National Renewable Energy Laboratory (NREL)

NREL is part of the DOE's Office of Energy Efficiency and Renewable Energy. It is a leading research and development facility that provides information on renewable energies. Resources such as GIS maps with renewable resources by area, renewable energy conferences, and many publications are available on the NREL website.

Website: [www.nrel.gov/](http://www.nrel.gov/)

The Colorado Renewable Energy Portal: Odysen

Odysen is an online newsletter that provides renewable energy resources for Colorado. The website includes calculators, upcoming events and links to other renewable energy resources.

Website:

[www.odysen.com/location/Main.php?s=Colorado](http://www.odysen.com/location/Main.php?s=Colorado)

Source Guides: The Source for Renewable Energy

Source Guides is a list of resources for renewable energy throughout the world. You can search by country, state or geographic location for businesses, products, and news that relate to renewable energy.

Website: [energy.sourceguides.com/index.shtml](http://energy.sourceguides.com/index.shtml)

Database for State Incentives for Renewable Energy (DSIRE)

DSIRE is a source of information on state, local, utility, and selected federal incentives that promote renewable energy. It includes resources for loans, rebates, green power, and much more. The site is organized by state so it is easy to identify the local resources.

Website: [www.dsireusa.org/](http://www.dsireusa.org/)

U.S. Energy Policy Act of 2005

Tax Credits

The Energy Policy Act of 2005 mandates credits for energy efficiency improvements and alternative energy, with most beginning in January 2006 and remaining in effect through 2007.

Website: [www.energy.gov/taxbreaks.htm](http://www.energy.gov/taxbreaks.htm)

## EA Credit 3: Additional Commissioning

This credit expands on the commissioning requirements from the Commissioning prerequisite and calls for additional best practices commissioning activities. The Additional Commissioning credit addresses commissioning activities during the Design and Post-Occupancy Phases with specific requirements to conduct a design review prior to the Construction Documents Phase, again near the completion of the Construction Documents, review contractor submittals of commissioned equipment and develop an energy management (Re-Commissioning) manual. This credit requires that the commissioning agent be an independent third party, and not part of the design or construction team.

### Recommendation:

- This credit is easily achievable for most projects, as proven by the 93 percent of Colorado projects that have earned this credit.
- Costs for implementing this credit can be reduced through planning and leveraging efforts made for the commissioning prerequisite (EAp1) and for the measurement and verification credit (EA5).

### Helpful Hints:

- A good rule of thumb is that the cost premium of the Additional Commissioning credit is an additional one-third the cost of the Fundamental Commissioning credit.
- The commissioning **MUST** be contracted prior to 100 percent design documents and the start of construction documents.
- Some requirements for this credit occur just prior to substantial completion. Note that LEED requires that documentation is "readily available" prior to submittal.
- When a Commissioning Authority reviews key submittals for compliance with the specifications and design intent, the whole project team benefits by getting an extra set of eyes to look at the details of equipment and control integration at a very early phase of the project. These reviews can help to integrate the equipment suppliers and control vendors prior to equipment being ordered, which facilitates on-site integration and keeps "head-scratching" to a minimum.

### QUICK FACTS

**Implementation:** Recommended.

**Historical Data:** 93% of Colorado LEED certified projects have successfully earned this credit.



Commissioning Field Work

*Courtesy: Architectural Energy Corporation*

### Examples:

- The Colorado Department of Labor & Employment's additional commissioning proved to be a valuable resource for maintenance staff. The efforts include a seasonal commissioning, a post occupancy (ten month) review and a systems and energy manual for ongoing facility maintenance.
- All three of the CH2M HILL Denver Campus buildings earned this credit. An added benefit was that the Facilities Engineer participated in the commissioning process, providing him with in-depth knowledge about the building systems even before the building was occupied.

### Resources:

See Fundamental Building Systems Commissioning credit (EAp1).



## EA Credit 4: Ozone Depletion

This credit expands on EAp2 to include the elimination of HCFC and halon from *all* equipment, again including central plant equipment.

### Recommendation:

- This credit is easily achievable for projects specifying new mechanical equipment. There has been controversy surrounding this credit, when projects use refrigerant based equipment, because many mechanical engineers have argued that the mechanical equipment which does not use HCFCs is generally less efficient and more likely to leak refrigerant. In response, the USGBC has revised their credit interpretation to allow for equipment which uses HCFC equipment in cases where it can be proven to be more environmentally benign for the project. See [www.usgbc.org/Docs/LEED\\_tsac/TSAC\\_Refrig\\_Report\\_Final-Approved.pdf](http://www.usgbc.org/Docs/LEED_tsac/TSAC_Refrig_Report_Final-Approved.pdf) and various Credit Ruling Interpretations (CIRs) for additional information.

### Helpful Hints:

- Small HVAC units that are used to cool equipment support rooms, such as computer, telephone and data rooms, are not considered part of the base building system and are not subject to the requirements of this credit.
- Evaporative cooling (direct or indirect) can a great solution for the dry Colorado climate, eliminating the need for refrigeration equipment.
- Also consider district cooling (chilled water distribution), if your project is in the Denver area.

### Examples:

- The Opus Northwest Construction Department of Transportation project in Lakewood, Colorado achieved this credit by installing chillers that use R-134a, which is a non-HCFC refrigerant.
- The Aspen Skiing Company's Snowmass Golf Clubhouse achieved this credit by using water-source heat pumps to provide heating and cooling. In addition to eliminating the need for refrigerants, the system also eliminates the need for a gas-fired boiler.

### QUICK FACTS

**Implementation:** Recommended.

**Historical Data:** 36% of Colorado LEED certified projects have successfully earned this credit.



**Snowmass Golf Clubhouse** uses the pond on Hole 18 of the golf course as a heat sink for water-source heat pumps in summer and winter, shown under construction (top) and completed (bottom).  
*Courtesy: Aspen Skiing Company*

### Resources:

See CFC Reduction in HVAC&R Equipment credit (EAp3).

## EA Credit 5: Measurement & Verification

The practice of measurement and verification contains two parts: the plan and the implementation of the plan after occupancy. Only the plan is required to earn LEED credit along with additional information regarding the scheduling and type of equipment which will be used to implement the plan. Actual implementation need not be demonstrated prior to submittal since, presumably, it will occur in the building after LEED certification. Projects often realize significant cost savings with the implementation of the procedures outlined in the Measurement and Verification Plan.

### Recommendation:

- One successful approach to measurement and verification monitoring is using short-term monitored data along with building automation trended data to address all of the energy conservation measures and end-uses that the USGBC desires. This approach does not require that a project add expensive monitoring equipment to their existing or new mechanical equipment.
- This credit has synergies with the Fundamental Building Systems Commissioning prerequisite (EAp1) and the Additional Commissioning credit (EAc3).
- Sophisticated Electrical Management Systems, Building Automation Systems or Direct Digital Control systems inherently include most of the required monitoring points.

### Helpful Hints:

- Target this LEED credit early and inform both the mechanical and electrical engineer to allow them to design their systems for easy monitoring (i.e. consolidating all the electric lighting circuits on one panel to allow for easy breakout of data.) These design requirements may be no-cost items, if part of the original design.
- Some requirements for this credit occur just prior to substantial completion. Note that LEED requires that documentation is “readily available” prior to submittal.

### QUICK FACTS

**Implementation:** Recommended.

**Historical Data:** 43% of Colorado LEED certified projects have successfully earned this credit.



Installation of data loggers to verify performance  
 Courtesy: Architectural Energy Corporation

### Examples:

- Fossil Ridge High School in Fort Collins and the Department of Transportation Project in Lakewood both successfully achieved this LEED credit by submitting a plan that complies with Option D of the International Performance Measurement and Verification Protocol (IPMVP).

**Resources:**Referenced Standard- International Performance Measurement and Verification Protocol, Volume 1, 2001 Version (IPMVP)

The IPMVP referenced standard is available for download at the IPMVP website. They also present best practice techniques, offer protocol development and technical training seminars among the many resources.

Website: [www.ipmvp.org/](http://www.ipmvp.org/)

ENERGY STAR: Portfolio Manager

The Portfolio Manager from ENERGY STAR is a free tool for benchmarking building energy performance. Simply enter 12 months of electricity and gas use and other basic information about the building (area, schedule, etc.) to get a preliminary score. A professional engineer is required to verify the score if an official ENERGY STAR label is desired (for buildings with a score of 75 or higher.)

Website:

[www.energystar.gov/index.cfm?c=evaluate\\_performance.bus\\_portfoliomanager](http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager)

U.S. Department of Energy Energy Efficiency and Renewable Energy (EERE)

The EERE has an M & V resource page that has a planning tool, report outlines, example scope of work and many other M & V related resources.

Website:

[www.eere.energy.gov/femp/financing/superespcsmvresources.cfm](http://www.eere.energy.gov/femp/financing/superespcsmvresources.cfm)

Association of Energy Engineers (AEE)

AEE has a program that teaches individuals about the basics of M & V and certifies them as Measurement and Verification Professionals. It also offers courses to prepare you for the required exam and gives an overview of the measurement and verification process.

Website:

[www.aeecenter.org/store/detail.cfm?id=757&category\\_id=4](http://www.aeecenter.org/store/detail.cfm?id=757&category_id=4)

Energy Efficient Design Applications: Measurement and Verification Documents

Lawrence Berkeley National Laboratory has provided this resource that includes guidelines, check lists, training opportunities, and other great resources for M & V. For more information, see the M & V Documents website.

Website: [ateam.lbl.gov/mv/](http://ateam.lbl.gov/mv/)

## EA Credit 6: Green Power

The Green Power LEED credit requires a two-year contract for 50 percent of the building's electricity cost in support of the generation of power from renewable sources. Currently there are three different strategies to achieve this credit in Colorado:

1. Contract *Green-e equivalent* power from Xcel Energy Fort Collins Utilities or others.
2. Contract *Green-e certified* power from suppliers such as Holy Cross, Colorado Springs Utilities, and Yampa Valley Electric Association.
3. Purchase Green-Tags from *any* Green Broker (example Renewable Choice, GT Energy).

### Recommendation:

- Cost premiums for green power have come down significantly over the last several years. It is now possible to purchase green power for a 1.0¢ per kWh premium or less. In fact, the price for a limited amount of wind power, announced in 2005 by Xcel Energy, was less than the standard electricity rate.

### Helpful Hints:

- Don't forget to contact your electric utility for availability and pricing comparison when shopping for green power.
- The project is guaranteed an Innovation in Design credit if it contracts for two years at 100 percent green power, or four years at 50 percent green power.
- Achieving this credit does not impact design or construction budgets. Cost premium is carried in owner's operations budget.
- Unlike many credits, this credit can often be considered until the last minute of a LEED submission. Implementation can even be added as needed as a re-submittal to the USGBC.
- Green power reps are savvy to LEED requirements in today's market and therefore, should be able to easily provide required submittal documentation.
- Onsite generation and solar hot water systems do not apply to this credit.

### QUICK FACTS

**Implementation:** Strongly recommended.

**Historical Data:** 57% of Colorado LEED certified projects have successfully earned this credit.



Platte River Power Authority Medicine Bow Wind Project supplies wind power to Fort Collins, Loveland, Estes Park and Longmont.  
*Courtesy: Platte River Power Authority*

### Examples:

- The University of Colorado at Boulder Student Union mandates a 100 percent subscription for green power *if* student fees are used to help fund building projects.



**Resources:**Referenced Standard: Center for Resource Solutions' Green-e Product Certification Requirement

Products that are labeled with the Green-e logo are greener and cleaner than the average electricity product sold in that region. The standard may be downloaded from the Green-e website.



Website: [www.green-e.org/](http://www.green-e.org/)

ColoradoEnergy.org

ColoradoEnergy.org provides information about green power available in the state of Colorado. The website lists places to sign up for green power in Colorado as well as local events and news briefs.

Website:

[www.coloradoenergy.org/issues/greenpower/default.htm](http://www.coloradoenergy.org/issues/greenpower/default.htm)

Database for State Incentives for Renewable Energy (DSIRE)

DSIRE is a database, organized by state that allows users to browse many renewable energy resources. Included in these resources is a listing of places in Colorado that currently purchase green power and how they are doing it.

Website:

[www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=CO](http://www.dsireusa.org/library/includes/map2.cfm?CurrentPageID=1&State=CO)

U.S. Environmental Protection Agency Green Power Partnership

The Green Power Partnership is a program that supplies information on renewable energy and where to buy in your region. The website has a list, by state, of participating utilities, what renewable source they are using and other useful information. It also lists products with Green-e certification and additional information.

Website:

[www.epa.gov/greenpower/locator/co.htm](http://www.epa.gov/greenpower/locator/co.htm)

U.S. Department of Energy (DOE) Green Power Network

The DOE's Office of EERE (Energy Efficient and Renewable Energy) has an online Green Power Network that has everything you need to know about green power including, state policies, pricing, renewable energy certificates and much more.

Website: [www.eere.energy.gov/greenpower/](http://www.eere.energy.gov/greenpower/)